Y-12

OAK RIDGE
Y-12
PLANT

MARTIN MARIETTA

CONCEPTUAL DESIGN REPORT

FOR

URANIUM CONTAMINATION CONTAINMENT

AND CONTROL IMPROVEMENTS

PROJECT 89-OR-GB-2

Prepared by
Martin Marietta Energy Systems, Inc.
Engineering

December 1986

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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ACRONYMS

ADM	action description memorandum
A-E	architect-engineer
ALARA	as low as reasonably achievable
CCZ	contamination control zones
DOE	Department of Energy
ORO	Oak Ridge Operations
EURI	enriched uranium recovery improvements
HEPA	high-efficiency particulate air
MAA	material access area
PAV	plant action value
QA	quality assurance
RZ	regulated zones
UCCCI	Uranium Contamination Containment and Control Improvement

EXECUTIVE SUMMARY

The purpose of the Uranium Contamination Containment and Control Improvements (UCCCI) project is to reduce the exposure of personnel at the Y-12 Plant to airborne uranium and to reduce the trackout of uranium to noncontrolled areas. The project is needed to comply with Department of Energy requirements to maintain personnel exposures as low as reasonable achievable. It will also provide a level of contamination control consistent with standard industrial practices for plant workers.

The UCCCI project includes three types of improvements:

1. isolation of uranium sources to minimize the generation of contamination, and

2. ventilation improvements to prevent the spread of contamination during routine operations and scheduled maintenance,

3. improved contamination control and monitoring facilities at the boundary of an enriched uranium recovery facility.

The estimated cost for the UCCCI project is $6 million. The project is scheduled to be completed by September 30, 1991.

1. INTRODUCTION

The Y-12 Plant routinely handles tonnage quantities of enriched and depleted uranium in the fabrication and assembly of a variety of nuclear weapon components and subassemblies. Uranium metal casting, forming, heat treating, and machining operations are employed in a number of production facilities. In addition, impure enriched uranium contained in production scrap and enriched uranium returned from Department of Energy (DOE) production reactors is processed through chemical recovery facilities. The various enriched uranium operations generate significant quantities of transferable uranium in the form of machine turnings, finely divided uranium-bearing ash and other scrap residues, and uranyl nitrate solutions. Depleted uranium operations generate significant quantities of uranium oxide powder, metal fines, and machine turnings. Uranium gets into the air and on the floor around the process equipment and is spread to adjacent areas by the relatively unrestricted movement of employees, tools, and equipment.

Radiological concerns are associated with all plant operations involving the processing and handling of enriched as well as depleted uranium. Enriched uranium has high alpha specific activity due to the concentration of U-234 along with the U-235. About 7 μg of highly enriched uranium (93% U-235) produces 1000 alpha disintegrations/min. About 1000 micrograms of depleted uranium produces 1000 alpha disintegrations per minute. There is general agreement among DOE

facilities that a surface alpha contamination level greater than 1,000 dpm/100 cm^2 is unacceptably high.

Although significant improvements have been made in many of the work areas to reduce the level of exposure of personnel to radioactive contamination, there remain processes, practices, and equipment which can significantly contribute to personnel exposure to radioactive contamination. The DOE as-low-as-reasonably-achievable (ALARA) guidelines (DOE Order 5480.1, Chap. XI, Sect. 4.f) dictate that systems be implemented to minimize exposure of workers to radioactive contamination; therefore, it is imperative that the presently existing contaminating sources be largely eliminated by providing better containment of the source operations.

In addition, opportunities exist for undesirable levels of uranium contamination to leave the plant on employee shoes, skin, hair, and clothing. While this poses a relatively low health and safety hazard, public perception of and outcry about such contamination could be damaging to the plant and subsequently jeopardize the overall weapons program. The general plant contamination problem has been and is being addressed thus far primarily through administrative and procedural controls and results are being audited by checking personal shoes and surface contamination in the various work and office areas. Demonstrable improvement has been made over the past several years. The health physics data show, however, that significantly better control has to be established if the plant contamination containment goals of reaching ALARA are to be achieved. Consequently, some capital improvements are required.

A number of the plant buildings and facilities have sufficient floor and equipment contamination to be of concern from a radiation protection point of view. Only a few of the areas, however, are contaminated directly by virtue of the particular uranium operation being conducted at that location. Most have no local contamination source but are contaminated indirectly, via various uranium transfer mechanisms, from the primary sources located elsewhere in the plant.

Comprehensive plant-wide studies have been performed to review every functional work area, considering level of contamination, type of production operation, materials handled, and operational interface, to identify all primary uranium contamination sources and contamination transfer pathways.

This project, Uranium Contamination Containment and Control Improvements (UCCCI), addresses specific building and process modifications and additions to the primary contamination source areas in the Y-12 Plant. The project scope is defined as required to establish the level of contamination control necessary to meet plant ALARA goals. The project's scope addresses the contamination problem in two ways: containing it at the source and preventing its spread.

The primary emphasis will be containment of uranium contamination at the source of generation. Where possible, the contaminating source process or equipment will be completely enclosed in conjunction with improved ventilation. When sufficient process isolation is not feasible, process area boundary controls will then be dictated.

2. GENERAL PROJECT DESCRIPTION

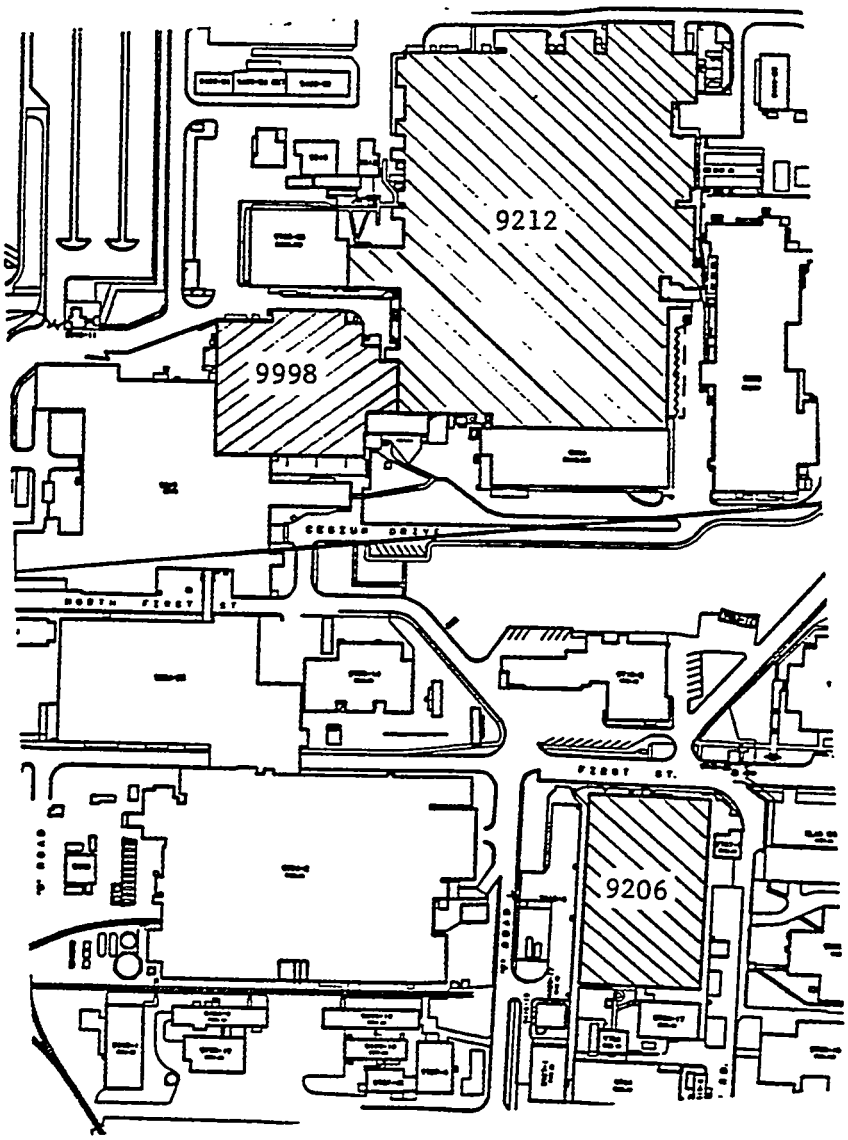
The plant location of the primary contamination source areas is shown in Fig. 1. This project proposes to control these sources in three ways:

1. isolating sources of contamination from adjacent areas to minimize the areas that must be controlled,

2. improving ventilation around contamination sources to control the spread of radioactivity, and

3. improving contamination control and monitoring at the clean/contaminated interfaces of an enriched uranium salvage facility.

Summary description of process and facility modifications and additions to be provided by this project are given in the following sections by building number.



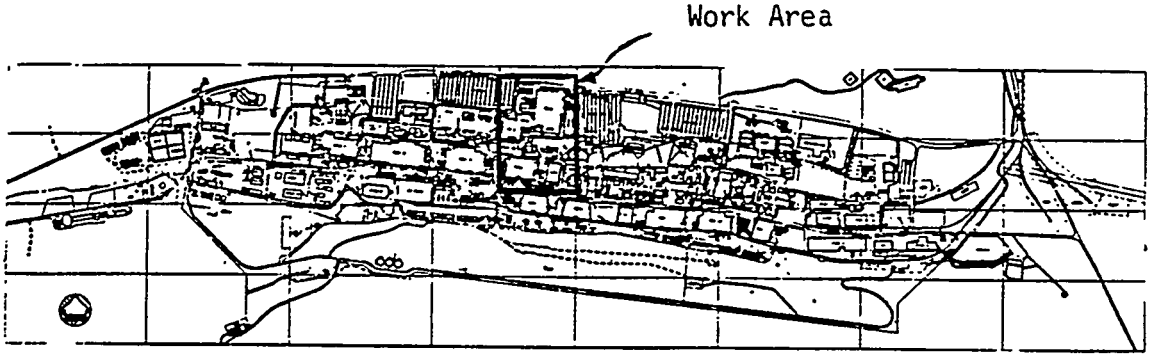


Figure 1. Location of Project Areas

2.1 PROCESS AND FACILITY MODIFICATIONS

2.1.1 Building 9212

The Building 9212 material access area (MAA) contains a variety of enriched uranium operations including chemical processing facilities for the dissolution of uranium metal and uranium compounds, uranium purification, and metal conversion as well as facilities for uranium metal casting.

There are several projects already planned and underway within the Building 9212 MAA which will enhance contamination control. Among these projects are Production Capability Restoration, Utility Systems Restoration, and Enriched Uranium Recovery Improvements (EURI). The EURI FY 1985 line item project will contribute most significantly to contamination control in the Building 9212 MAA through contamination control-related modifications. The UCCCI line item project will provide additional contamination control measures beyond the scope of the EURI effort.

Specifically, the UCCCI project will provide for additional source contamination control measures. High-efficiency particulate air (HEPA) filter housings will be converted to a bag-in/bag-out design and vacuum traps will be contained within ventilated enclosures. These modifications will eliminate one of the largest sources of contamination in the Building 9212 MAA.

2.1.2 Building 9206

Building 9206 contains a variety of enriched uranium operations including chemical processing facilities for uranium purification and metal conversion. Building 9206 also contains facilities outside the MAA for the handling of depleted uranium chips.

To provide better source contamination control within Building 9206, ventilated process enclosures will be provided to house all vacuum traps. In addition, HEPA filters will be converted to bag-in/bag-out filters. In addition, one major shoe/scuff exchange facility will be provided for the north entry point into the work area. To provide room for this facility, an existing lunchroom will be moved to another location.

2.1.3 Building 9998

Building 9998 houses the H-1 Foundry where depleted uranium is cast. To reduce the exposure of personnel to radioactive contamination, contamination levels in the work area will be reduced by implementing a contained furnace brick cleanout station, and an oxide burner dust collector enclosure.

2.2 SUMMARY OF ALTERNATIVES

2.2.1 No Action Alternative

The no action alternative was considered. If this alternative were adopted, DOE's commitment to reduce personnel exposure to uranium contamination as low as reasonably achievable would not be met and the plant would continue to accept a greater risk of contamination leaving the plant. Although the plant has already instituted administrative controls, past DOE audit teams have recommended more stringent contamination control. To institute tighter controls, capital improvements will be required. For these reasons, the no action alternative is not acceptable.

2.2.2 Contamination Control Zones and Regulated Zones

The Y-12 Health Physics Department has defined two levels of control for the contaminated areas of Y-12. Those areas which maintain floor smear levels greater than 25 d/m/100 cm^2 (alpha) but less than 500 d/m/100 cm^2 (alpha) have been designated regulated zones (RZ). Those areas with floor smear levels greater than 500 d/m/100 cm^2 (alpha) are considered to be contamination control zones (CCZ). It has been found through health physics studies that floors with removable floor contamination levels below 25 d/m/100 cm^2 normally will not result in shoe contamination above 1000 d/m/100 cm^2. These areas, therefore, have been defined to be clean.

Several alternatives were considered in sizing the CCZs and RZs for the UCCCI project. One concept would be to designate the entire plant a CCZ or RZ with control at the plant boundary. Another concept might be to designate the western exclusion area a CCZ or RZ. These alternatives minimize operational constraints and costs and might meet the objective of preventing contamination transport outside the plant. However, spread of contamination throughout large areas of the plant would occur and many more people would be exposed to contamination. These concepts would not be in keeping with ALARA guidelines. Therefore, the current size of Y-12's CCZs or RZs, which are as small as operational constraints will allow, was maintained.

2.2.3 Improved Clean/Contaminated Interface Control

One way to reduce the spread of contamination would be to improve the control of material and personnel leaving a CCZ or RZ. Improvements could include greatly expanded shoe exchange facilities at the CCZ or RZ boundary and the installation of cleaning stations for vehicles or barricades to prevent vehicular flow into and out of areas of contamination. While such an approach would reduce the spread of contamination, it would not reduce personnel exposure significantly. Since exposure reduction is the main purpose of an ALARA program, the emphasis in this project is on source control. Improved interface control is provided in the project, but only where the potential for significantly reducing personnel exposure exists.

2.2.4 Total Source Control

Total containment of all uranium processes and operations was also given consideration. Although the greatest worker protection could be realized by instituting these plutonium-type controls, this alternative was not deemed to be acceptable. Such modifications would greatly inhibit productivity and would be extremely difficult and impractical to implant into the existing Y-12 Facility. In addition, the cost to achieve only minimal improvement over the modifications proposed for this project would be unreasonable.

2.2.5 Selected Alternative

The approach ultimately selected for the UCCCI project contains aspects of Sects. 2.2.3 and 2.2.4. Operations which have been shown to be contamination sources will be contained. In addition, improved clean/contaminated interface control will be provided for Building 9206. These improvements will result in benefits similar to the two previous sections, but in a much more cost-effective manner.

3. JUSTIFICATION

3.1 STRATEGIC NEEDS

Although significant improvements have been made to improve contamination control in the Y-12 Plant, there are still operations which consistently result in uranium contamination levels, both in the air and on surfaces surrounding the operation, above the plant action values (PAV). PAVs are contamination levels which are 10% of the radiation protection standards mandated in DOE Order 5480.1, Chap. XI. These values signal the need for action prior to reaching radiation protection standards. Since the DOE and the operating contractor are committed to the principle of maintaining personnel exposure to uranium contamination, "ALARA," measures must be taken to contain these contamination sources.

The contamination control problem has been and is being addressed thus far primarily through administrative modifications and procedure changes and audited by the use of air sampling monitors, the checking of personal shoes, and by extensive smear checking of surface contamination. Demonstrable improvement has been made. The data show, however, that further improvement needs to be made if confidence is to be attained that personnel exposure to uranium contamination is "ALARA" and that people do not leave the plant with skin, clothing, or shoes having alpha levels higher than 1000 d/m/100 cm^2. This level is considered the minimum acceptable since DOE guidance on maintaining exposures ALARA (DOE/EV/1830-T5, Sect. 5.4) states that no contamination should be

detectable at the interface of an uncontrolled area. Recent health physics air contamination data (shown in Fig. 2) for the MAAs of Buildings 9212 and 9206 illustrate this point quite well. It can be observed from this data that a significant percentage of the air monitors within the area are indicating uranium air contamination greater than the PAV of 22 d/min/m^3. Although a smaller percentage of the air monitors are registering uranium contamination greater than the radiation protection standard mandated in DOE Order 5480.1, Chap. XI (220 d/min/m^3), the number is not insignificant. Such conditions require extensive use of respiratory protection equipment.

In addition, a personal shoe contamination survey performed by the Health Physics Department on the personal shoes of employees assigned to shoe control areas over a 3.75 year period, indicated that approximately 13% of the personal shoes had shoe contamination above the PAV of 1,000 d/m/100 cm^2.

3.2 ECONOMIC CONSIDERATIONS

The proposed project will probably not reduce the cost of nuclear weapon production. However, the economic impact of the loss or impairment of the Y-12 Plant in the manufacture of nuclear weapons because of a general contamination problem, either real or perceived, is incalculable.

Impact on operating costs was given careful consideration in proposing contamination control improvements. Whenever possible, an

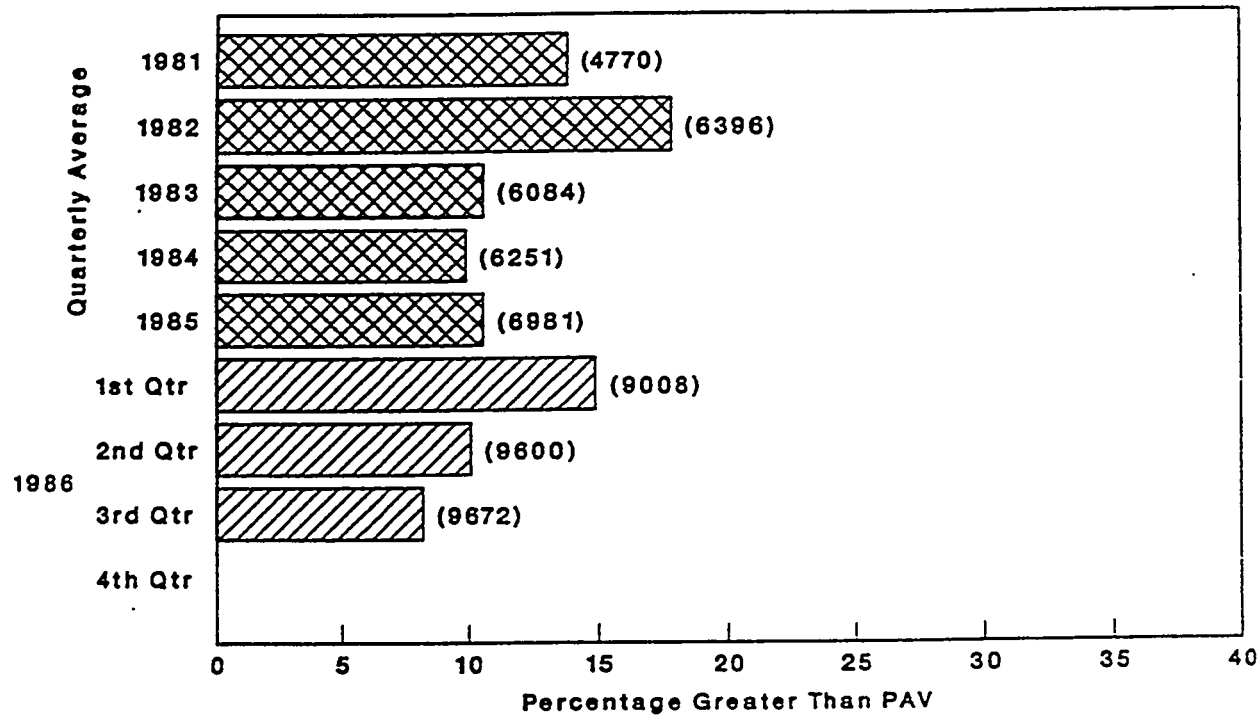


Figure 2. Air monitoring in operating areas--air samples for enriched uranium. Percentage greater than PAV = 22 d/min/m^3 (Number of Samples).

attempt was made to improve operations and reduce costs by improving the flow of materials. In some cases, operating costs will be reduced by implementing the proposed modifications. In other cases, restrictions such as the shoe change station will constrain personnel mobility and may cause increased operating costs. Wherever this occurs, the modifications were designed to minimize the adverse cost impact. Overall, the project will result in a small increase in plant operating costs for operation and maintenance of the new facilities. This increase is estimated to be approximately $3,700/year. In general, the facility modifications are of a structural nature and require little in operating and maintenance costs.

3.3 IMPACT IF NOT FUNDED

As discussed in Sect. 4.1, administrative controls alone have not resulted in Y-12's attainment of its ALARA goals. The purpose of this project is to provide the additional controls needed to reduce exposures.

If the project is not funded, efforts to reduce exposure will still continue. However, these efforts will be hampered by the nature of the contamination sources themselves. For example, changeout of filters involves removing a uranium dust-laden unit. Even a small amount of jostling will result in the dust creating a contamination problem. Furthermore, no amount of administrative control will effectively prevent such contamination.

Therefore, the impact of not funding this project will be continuing contamination problems at the Y-12 Plant. Appropriate administrative controls have already been successfully applied to reduce the problem.

Significant reductions beyond that achieved by administrative control requires capital improvements.

4. SIGNIFICANT FACTORS

4.1 PROJECT REQUIREMENTS

All modifications and additions proposed in this project will address minimization of personnel exposure to uranium contaminants. In general, this will be accomplished by isolating and containing contamination sources and by improving contamination track-out. Equipment will be provided to improve the particularly dirty operations. No major uncertainties exist for the modifications and additions described.

There is, however, one area of uncertainty regarding DOE radiation protection requirements. The existing DOE radiation protection standards (DOE Order 5480.1, Chap. XI) are being replaced with a new DOE Order 5480.11. When this new order is implemented, the project's scope will be reviewed to ensure consistency with its requirements.

4.2 TECHNICAL CONSIDERATIONS

There are few technical uncertainties associated with the project. The environmental control technologies proposed are industrially proven with a long history of successful applications in the Y-12 Plant and similar production plants and laboratories.

As with all processes handling enriched uranium, criticality safety is a continuing concern. The proposed equipment in Buildings 9206 and 9212 has the potential to be critically unsafe. Preventive measures, such as administrative controls, "safe geometry" containers, and the exclusion of water, will ensure criticality safety. At the time of Title I design, the latest criticality safety requirements and policies will be cited as project requirements. During the engineering design, administrative controls will be detailed. This will ensure that the as-built systems can be operated in a critically safe manner, without resorting to expensive retrofit or to use of administrative controls which might be an unacceptable hindrance to operations activities. Operations, engineering, and criticality safety personnel will work together throughout the design phase so that criticality controls, and the methods of implementation, are agreed to in the earliest possible stages.

4.3 OPERATIONAL CONSIDERATIONS

No significant operational uncertainties have been identified that relate to this project. However, the operational interface is quite

important. The proposed modifications and additions will interface with a considerable portion of the Y-12 Plant production operations. These interfaces include tie-ins to existing and planned process facilities.

Periodic testing of the HEPA filter systems will be necessary to ensure installed design removal efficiencies are maintained. Metal Preparation Division will be responsible for the dioctyl phthalate testing of enriched uranium exhaust systems. The Y-12 Plant Utilities Department will be responsible for testing filter systems installed on depleted uranium exhaust systems. Further, Utilities will be responsible for filter changeout and maintenance on the depleted uranium exhaust systems.

Routine maintenance of the environmental control systems will be provided by the Y-12 Plant Maintenance Division. In addition, Y-12 Maintenance will be responsible for the installation of replacement filters in major enriched uranium processing exhaust systems. Contaminated filters will be removed by Production personnel for uranium recovery.

Schedules must be developed and work coordinated in conjunction with operations personnel and the project team. In some cases, it will be necessary to essentially complete installation of systems or equipment items prior to demolition of existing equipment in order to minimize production process downtime.

Field construction time will be minimized in certain production areas by off-site fabrication of equipment modules requiring only field assembly and tie-ins to building services. Equipment will be tested, where possible, prior to delivery to the construction site. In some

cases, on-site preinstallation testing will be performed to give further assurance of minimum production outage and operational readiness.

The project's construction activities and operation of its facilities will generate low-level radioactive solid waste. This waste will be disposed of in existing Y-12 facilities. Since the amount of additional waste generated by this project is small in relation to the total waste volume, no impact on this operation is foreseen.

4.4 SPECIAL REQUIREMENTS

The new environmental control devices must have a high availability factor. An onstream efficiency of at least 95% will be required. If the new systems cannot be maintained onstream, then certain affected operations may be forced to shut down until equipment deficiencies are corrected. This could have an adverse impact on production schedules and rates. Fortunately; most of the new systems are highly reliable and represent well developed, mature technologies. Experience with similar installed systems has shown that current plant operating procedures address the system availability in a satisfactory manner. Therefore, a detailed analysis of performance requirements is not necessary.

4.5 CONSTRAINTS

Major project implementation constraints exist in the areas of: (1) criticality safety, (2) safeguards and security, (3) personnel protection, (4) production continuity, and (5) project interfaces.

4.5.1 Criticality Safety

Criticality safety is the top priority at the Y-12 Plant. Extreme caution must be exercised in the demolition of all process systems and the connection of new facilities to existing enriched uranium production operations.

Since the UCCCI project will be replacing emission controls on enriched uranium exhausts, additional constraints are required. HEPA filters will be changed on a scheduled basis. These systems must be maintained dry to ensure criticality safety. Administrative controls will also be necessary to ensure that the filter maintenance and testing program is implemented. Stringent administrative controls as well as prudent design will be required to prevent the accumulation of enriched uranium in ductwork and filter housings.

4.5.2 Safeguards and Security

Safeguards constraints will force restrictions on the flow of construction materials and personnel within a MAA. The use of isolation

walls will be investigated so that as much of the construction scheduled for existing MAAs as possible can be done in a nonregulated zone.

4.5.3 Personnel Protection

The health and safety of personnel associated with the construction phase of the UCCCI project will be protected at levels established by federal, state, and plant standards. A high degree of care will be required to ensure that conditions in contaminated and potentially contaminated areas of the plant are consistent with DOE's ALARA philosophy.

4.5.4 Production Continuity

It will be necessary to essentially maintain production throughout the construction phase of the project. Only minimum process downtime can be allowed. Construction plans and schedules will be closely coordinated with production schedules and responsive to operations needs and priorities.

4.6 INTERFACES

The primary external interfaces of the facilities and systems to be provided by the UCCCI project will be the control of effluents and utilities distribution networks.

4.6.1 Process Effluents

Solid wastes will be generated as a by-product of the proposed environmental control systems operation. Large amounts of treated air will also be released after processing.

The gaseous effluents will consist of the process exhaust from various production operations after treatment to reduce radionuclide emissions. These effluents will be discharged after monitoring (via existing systems) to establish emission levels.

Solid wastes will consist of spent HEPA and roughing filters. These materials will be surveyed to establish their contamination levels. Based on this survey, the wastes will either be reprocessed to reclaim uranium values (for filters containing enriched uranium) or shipped to the Y-12 low-level solid radwaste disposal facility. The additional volume of low-level waste will not create a major input on this facility.

4.6.2 Utility Requirements

The utilities requirements consist of instrument air, fire water, steam, and electrical power. Tie-ins to existing Y-12 Plant distribution networks will be provided for the remaining utilities. These systems have sufficient existing capacity to meet currently identified UCCCI needs.

5. ASSESSMENTS

5.1 SAFETY, FIRE, AND HEALTH

5.1.1 Safety Assessment

A safety assessment for this project is being prepared. No safety systems have been identified. If any subprojects are identified where additional safety documentation are required, a Preliminary Safety Analysis Report will be completed prior to the start of Title I design.

5.1.2 Industrial Safety

No unusual safety hazards will be created as a result of the UCCCI project. Where applicable, equipment will be fitted with protective devices to prevent operator injury. All work will conform with applicable safety-related codes and standards.

5.1.3 Radiological Safety

The purpose of this project is to reduce personnel exposure to radioactive materials. Radiological safety will be enhanced as a result of this project. The health and safety of personnel associated with the construction phase of the UCCCI project will be protected at levels established by federal, state, and plant standards. A high degree of care will be required to ensure safe working conditions in contaminated and potentially contaminated areas of the plant.

5.1.4 Fire Protection

Automatic sprinkler systems and fire alarms will be added or modified to provide the required fire protection for new or modified facilities, except where enriched uranium is present. If it is, heat detectors will be used to alert plant personnel of a fire. The effectiveness of emergency exits, fire doors, and fire walls will not be reduced.

5.1.5 Nuclear Criticality Safety

Though this project involves the design, procurement, and installation of new or modified equipment for numerous phases of highly enriched uranium processing, hazards, risks, and safety systems are not different from those normally encountered in the processing of enriched uranium. Usual physical controls for criticality safety purposes will be utilized where practical. Examples of such physical controls include, but are not limited to, geometry restraints, backflow prevention, mass control, and waste stream monitoring and control. Physical controls are supplemented, as necessary, by administrative controls such as single-batch handling, double-confirming analyses, and job training. Where practicable, reliance will be placed on equipment design in which dimensions are limited, rather than on administrative controls. All fissile material processes and equipment require review, safety analysis, and approval prior to operation as per Y-12 Plant Procedure 70-150.

5.2 QUALITY ASSURANCE

All portions of the project have been reviewed and preliminary quality assurance (QA) actions have been identified. As the project reaches the design criteria phase and is more fully defined, the project will be reassessed. The resulting QA plan will identify specific QA actions to be taken and the Operating Contractor personnel responsible for those actions. The plan will also provide QA guidance for all follow-on participants. At the completion of Title II design, the project will be further reassessed and the plan revised as necessary. Specific design, procurement, software, and construction QA documents will also be developed as appropriate for this project in accordance with applicable QA procedures. All actions will be entered into and monitored via the QA action tracking data base.

5.3 ENVIRONMENTAL ASSESSMENT

An action description memorandum (ADM) is being prepared for the UCCCI project. This ADM documents that the project will have minimal impacts on the environment. A summary of the ADM's key points follows.

5.3.1 Proposed Action

As has been discussed in previous sections of this document, environmental control devices and associated support items are to be provided for various Y-12 Plant production operations to facilitate

compliance DOE ALARA requirements. There are no better alternatives to the proposed actions which will meet environmental protection requirements.

5.3.2 Affected Environment

The Y-12 Plant is part of the Government-owned Oak Ridge reservation. Residential areas of the City of Oak Ridge lie approximately one mile to the north of the plant. The project is in existing facilities located within the Y-12 Plant security fence.

5.3.3 Environmental Consequences

Solid wastes and treated air will be generated or processed by the proposed facilities.

5.3.3.1 Gaseous Effluents

The purpose of the UCCCI project is to contain sources of uranium contamination within the Y-12 Plant and to prevent their spread to personnel and the environment. The subject systems will be designed to achieve this goal. Therefore, the operation of the proposed facilities will have a beneficial impact on the environment by reducing the discharge of uranium.

5.3.3.2 Solid Wastes

Solid wastes will consist of contaminated construction debris and spent HEPA and roughing filters. These materials will be surveyed to establish their contamination level and then reprocessed, stored, or buried in approved radioactive waste disposal areas in accordance with existing environmental regulations.

5.3.3.3 General

The design, construction, and operation of the new and modified facilities will be coordinated with federal, state, and local plans and will be in compliance with all applicable laws and regulations.

No additional land will be required to implement this project as it involves installation of facilities in an existing developed property. Waste from the construction phases will be minimal and will be disposed in an environmentally safe manner. Natural resources will be insignificantly affected by the acquisition of the construction materials necessary for this project.

5.4 ENERGY CONSERVATION

5.4.1 Analysis Methods

Previous studies in accordance with Subpart A, "Methodologies and Procedures for Life Cycle Cost Analysis," of 10 CFR Part 436, dated

October 27, 1980, were used to select the energy conservation features used in this project.

5.4.2 Major Energy Conservation Features

1. Life cycle costing techniques will be used in the design and procurement of energy consuming equipment.

2. Electric motors will be the high-efficiency type.

3. Energy consuming equipment will be shut down or operated under reduced load where possible during weekends and off-shifts provided personnel safety, accountability, or equipment are not compromised.

4. Glove boxes, in lieu of open-faced hoods, will be used insofar as possible in this project to enclose process equipment and effect containment of radioactive contamination. This will result in reducing the once-through exhaust ventilation load to a minimum, and consequently reducing the energy demand for heating, cooling, and dehumidification of the operating environmental air to a minimum.

5.4.3 Evaluation of Renewable Energy Resources

Current studies have shown that active solar energy systems are not cost effective in local DOE facilities; therefore, it is anticipated that a solar energy system for use on this project would not be cost effective.

5.4.4 Evaluation of Nonrenewable Energy Resources

Modifications in Building 9206 will require modifications to the heating and ventilation system. Oil and geothermal energy sources are not feasible alternatives for the project's heat source. Electric resistance heat was considered as an alternative to steam, but numerous life cycle cost analyses have shown steam to be the more cost effective. Since steam is readily available, electric resistance heating would be at an even greater disadvantage and is, therefore, not planned for use in this project.

5.4.5 Estimated Building Energy Use

Most of this project consists of modifications to portions of existing buildings, so calculations of building energy usage will not be necessary.

6. METHOD OF ACCOMPLISHMENT

6.1 DEPARTMENT OF ENERGY

The DOE will provide overall project management; review and approve Titles I, II, and III documents; and administer all prime contracts. All participants will be under prime contract to the DOE.

6.2 MARTIN MARIETTA ENERGY SYSTEMS, INC.

Energy Systems will prepare design criteria, review and recommend for DOE approval Titles I and II design documents prepared by the architect-engineer (A-E), provide support to the A-E for Title III engineering and inspection services, and review the project cost estimate. Energy Systems will perform Titles I and II engineering on the Furnace Brick Cleanout Facility, and the oxide burner modifications. Energy Systems will also procure specialty items needed for these modifications (e.g., bellows assemblies, local area exhausts, etc.). The demolition and site preparation work associated with critical areas in the MAAs of Buildings 9212 and 9206 will be performed by Energy Systems. Title III engineering for all work in these same areas will be performed by Energy Systems. Energy Systems will perform isolation activities required to minimize the risk of a criticality incident and maintain operation continuity. Miscellaneous field services as required for tie-ins to existing utility systems, testing, and preoperational check-out will be performed by Energy Systems.

6.3 ARCHITECT-ENGINEER

The A-E will be responsible for preparation of the design drawings, specifications, and cost estimates for Titles I and II for all Rust construction, except that assigned to Energy Systems. Title III engineering, except that assigned to Energy Systems, will be performed by the A-E.

6.4 RUST

Rust will perform all construction procurement and remodeling except that specified for Energy Systems.

7. PROJECT SCHEDULE

7.1 SUMMARY

The summary project schedule is shown in Fig. 3. It reflects the obligation of funds beginning in FY 1989, with the majority of Titles I and II design being performed by an A-E. Energy Systems will design modifications to special equipment (as noted in Sect. 6.2). All design work will be completed by December 1989.

Energy Systems will be responsible for procurement for items where Energy Systems has designed modifications (Building 9998). Remaining procurements for Buildings 9206 and 9212 will be performed by Rust, after their construction estimate has been prepared and approved.

Construction in all areas will be performed by Rust. Energy Systems will be involved in construction (demolition, site preparation, and tie-ins) around sensitive operating areas.

UCCCI SUMMARY - WBS 1.0

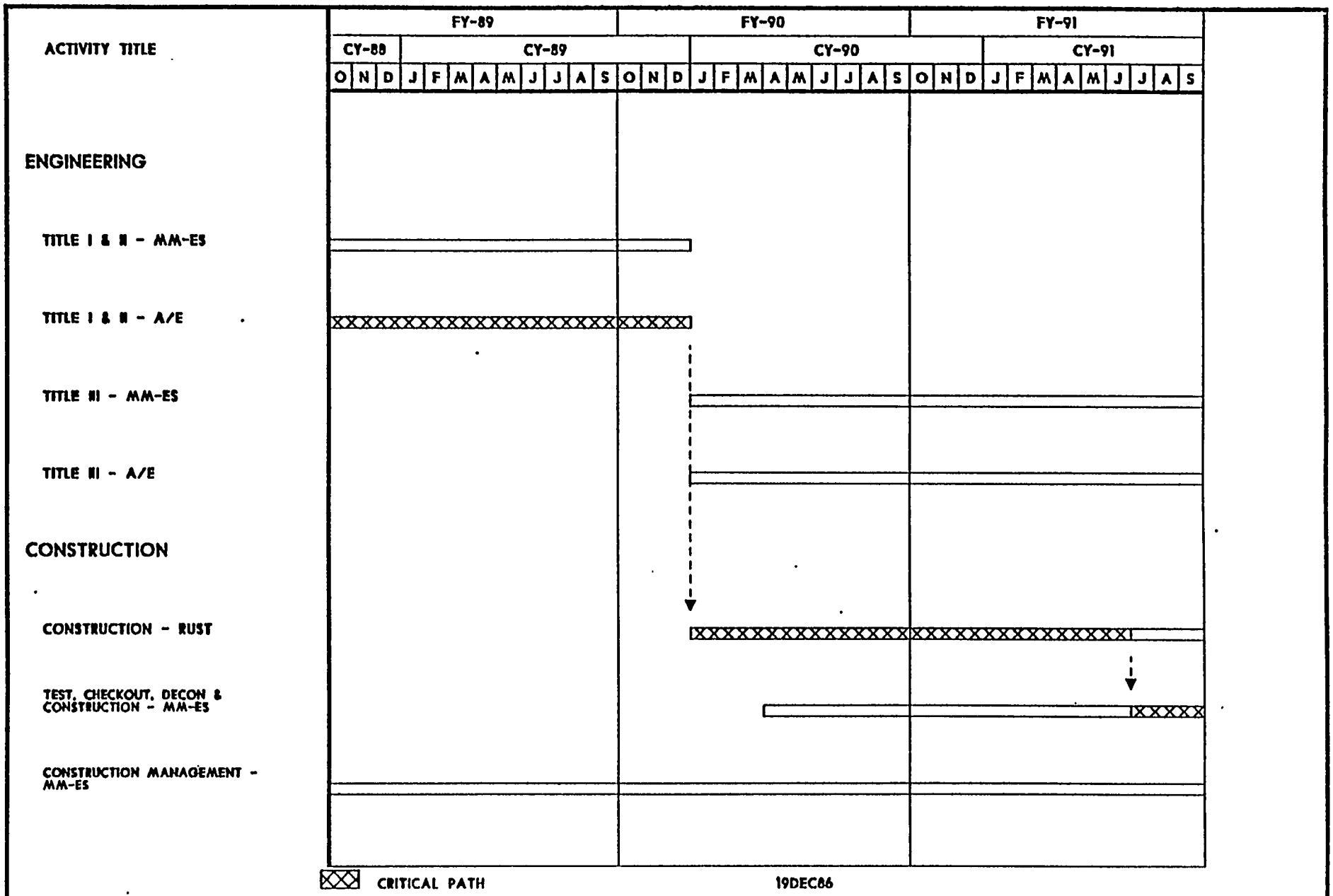


Figure 3 Project Schedule

7.2 CRITICAL PATH

The subprojects which become the critical path are Buildings 9212 and 9206. These subprojects call for the replacement of existing HEPA filter housings with bag-in/bag-out-type systems and the enclosure of vacuum traps. In addition, the Building 9206 subproject includes the installation of a new shoe exchange area.

The installation of the new filter housings and the enclosures has the potential to disrupt plant operations since the systems they replace serve existing equipment. In order to minimize shutdowns, work on each filter system or enclosure will have to be scheduled individually. This extensive amount of coordination led to these two subprojects being on the critical path.

Every effort will be made to expedite the construction schedule, consistent with Criticality Safety requirements and the need to maintain plant operations.

8. COST ESTIMATE

8.1 SUMMARY

The total project cost for the UCCCI project is $6 million. The costs for individual project participants are summarized in Table 1.

In the following sections, details are provided on each of these cost components.

8.2 BASIS FOR ESTIMATE

8.2.1 Engineering

The engineering cost estimate is based on detailed man-hour estimates prepared by each participating discipline. The man-hours are based on number of engineering documents (drawings, specifications, etc.) and management manpower required to execute this project. The estimated number of man-hours required was developed based on actual experience required to perform similar type projects. Separate worksheets were provided by each discipline for each WBS element and summarized to the total project. Man-hour requirements were projected for both the operating contractor and the A-E.

As discussed in Sect. 6.2, Energy Systems will perform Titles I and II engineering in a number of areas where specialty interfaces with operating equipment or modifications to existing equipment is required. Such facilities include the furnace brick cleanout facility and modifications to an oxide burner. All other detailed design will be performed by the A-E selected for the project.

8.2.2 Construction

The construction cost estimate is based on conceptual design bills of material. The detailed bills of materials were prepared by each participating design discipline for each Work Breakdown Structure (WBS)

Table 1. Cost estimate by participant
(dollars in thousands)

	Energy Systems	A-E	Rust	Total
1. Engineering (Approximately 20% of Construction Costs)				
Design	$ 84	$535		$ 619
Inspection	100	92		192
Project Management				
Total Engineering	$ 184	$627		$ 811
2. Construction				
1.1 Building 9212	422		1,627	2,049
1.2 Building 9206	337		1,489	1,826
1.3 Buildings 9998	52		172	224
Total Construction	$ 811		$3,288	$4,099
3. Subtotal	$ 995	$627	$3,288	$4,910
4. Contingency (Approximately 22% of Subtotal)	221	139	730	1,090
5. Total	$1,216	$766	$4,018	$6,000

element. Labor and material pricing is based on actual experience, current vendor quotes, in-house pricing data bank, R. S. Means, Richardson's Estimating Service, and other nationally recognized publications. The latest DOE-Oak Ridge Operations (ORO)-approved Rust labor rates and mark-ups for Oak Ridge were used. The estimated costs were then summarized according to WBS element and construction participant and then summarized to the total project by participant and DOE first-level cost code (i.e., building modifications, special facilities, etc.).

Energy Systems will perform site preparation and demolition work in sensitive operating areas and will make tie-ins. All other construction will be performed by Rust Engineering, due to the potential for exposure to radioactivity and/or toxic materials.

Procurement of special process equipment (e.g., bellows assemblies for the furnace brick clean-out facility) will be performed by Energy Systems. All other procurement will be performed by Rust.

8.2.3 Contingency

The project contingency was determined through a detailed analysis for each WBS element and summarized into the total project. A total contingency of $1,100,000 resulted which represents 22% of the Engineering and Construction budgets.

8.2.4 Escalation

The procurement and field construction base year estimates were escalated to the midpoints of delivery and construction using the current project schedule. The base engineering estimates were escalated into the periods when the work is projected to take place. The escalation rates used were the latest DOE-ORO-approved rates for Oak Ridge: 3% in FY 1987, 4% in FY 1988, 5% in FY 1989, and 5.5% thereafter.

8.3 COSTS AND FUNDING PLAN

The cost and obligations schedule for the UCCCI project is summarized in Table 2.

During FY 1989, funds will be obligated for Titles I and II design.

During FY 1990, the remainder of design and procurement funds will be obligated. Major construction contracts will be awarded. Construction funds will be obligated through FY 1991.

Table 2. Cost and obligation schedule
(dollars in thousands)

Fiscal Year	Authorizations	Obligations	Costs
1989	1,000	1,000	900
1990	3,000	3,000	1,900
1991	2,000	2,000	3,200
Total	6,000	6,000	6,000